IN THE MATTER OF
THE ROYAL COMMISSION INTO NATIONAL
NATURAL DISASTER ARRANGEMENTS

Witness Statement

Statement of: **Sharanjit Paddam**

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I, **Sharanjit Paddam**, Fellow of the Institute of Actuaries of Australia (Actuaries Institute) and Convener of the Actuaries Institute's Climate Change Working Group, say as follows:

Describe (in summary terms) your key qualifications, professional experience and associations.

1 My key qualifications are:

- Fellow of the Institute of Actuaries of Australia, Fellow of the Institute & Faculty of Actuaries (UK)
- Master of Science & Technology in Mathematics (UNSW), Master of Arts (University of Cambridge), BA Hons in Mathematics (University of Cambridge)

2 Since 1994, I have practiced as an actuary specialising in general insurance and I qualified as a Fellow in 2000. My professional experience includes:

- Principal Actuarial Consultant at PricewaterhouseCoopers in London 1994-2002
- Actuarial Advisor at Suncorp in Brisbane 2002-2004
- Actuary at Taylor Fry Consulting Actuaries in Sydney 2004-2016
- Principal at Deloitte Australia in Sydney 2016-2018
- Head of Environmental Social and Governance Risk at QBE Insurance Group in Sydney 2018-present

3 Since 2016, I have advised insurance companies, banks and asset owners on the risk management, strategy and disclosure of climate-related risks and opportunities.

4 My relevant associations include:

- Convener of the Actuaries Institute's Climate Change Working Group since 2016
- Co-chair of The Australian Sustainable Finance Initiative's Technical Working Group 3 on Better Informed Decisions since 2019
- Member of the Steering Group of the Climate Measurement Standards Initiative since 2019
- Member of the Insurance Council of Australia's Climate Change Action Committee since 2019
- Member of the Investor Group on Climate Change's Physical Risk & Resilience Working Group since 2018
- Contributing Author for the Intergovernmental Panel on Climate Change's Assessment Report 6, Working Group II, Chapter 11 – Australasia

Q2 What is the relevance (if any) of changes in climate, severe weather, natural perils and/or natural disaster risk to the work of actuaries?

Actuaries advise insurance companies and others on financial risk

5 Actuaries routinely work in multidisciplinary teams in areas such as natural disaster modelling and climate change. They advise governments, insurers, banks, regulators and international bodies, such as the United Nations among others, on the financial management of natural disasters. As natural disasters can have, and climate change will likely have, pervasive and profound impacts on families, communities, businesses and the economy, actuaries and the Actuaries Institute also consider climate change from the perspective of public policy.

6 Australian legislation requires insurers to appoint an actuary, namely section 39 of the *Insurance Act 1973 (Cwth)* for general insurers, section 93 of the *Life Insurance Act 1995 (Cwth)* for life insurers and section 106 of the *Private Health Insurance (Prudential Supervision) Act 2015 (Cwth)* for health insurers. Under Prudential Standard CPS 320 set by the Australian Prudential Regulation Authority (APRA), the Appointed Actuary must provide impartial advice to the insurer's Board, including on matters such as the valuation of insurance liabilities, pricing and adequacy of premiums, investment and reinsurance strategies, overall risk management framework, capital management, current and future capital adequacy, and consideration of the protection of policyholder interests.

7 As part of fulfilling the prudential requirements, Appointed Actuaries at life insurers and health insurers may consider the extent to which climate change may impact human health, and how this may affect mortality and morbidity.

8 Typically, insurance companies have teams of internal and external actuarial advisers performing a range of functions both in support of the Appointed Actuary and outside the focus of the Appointed Actuary.

9 In addition to the above, many actuaries fulfil other roles at insurers including Chief Executive Officers, Chief Risk Officers and Non-Executive Directors, and so have a wider remit.

10 The remainder of this statement is focused on the work of actuaries for general insurers.

11 For general insurers, actuaries provide professional advice on the financial management of climate and natural disaster risk, including:

- The pricing of insurance policies
- Valuation of liabilities for future claims payments and expenses on policies
- The modelling and management of capital requirements including modelling of reinsurance programs
- The development and implementation of risk management frameworks

Insurance companies provide policies that cover financial losses arising from natural disasters

12 Australian general insurance companies provide insurance policies for products such as home and contents insurance and commercial property insurance, that provide certain coverage to policyholders from the impact of severe weather, natural perils and natural disaster risks. These can include earthquakes, tsunamis, storms, tropical cyclones, floods and bushfires. Actuaries must therefore closely consider the impact of these natural perils on the pricing of insurance policies, valuation of liabilities, capital and reinsurance requirements and risk management frameworks.

Actuaries include allowance for natural disasters in pricing insurance contracts

13 For retail products such as home and contents insurance and car insurance and for commercial property insurance for small and medium enterprises, pricing is usually determined through actuarial analysis. Actuaries perform statistical analysis of historical claims information to understand the drivers of claims frequency and severity for different groups of policyholders. From this and other relevant data they build predictive models for the cost of such claims, incorporating the results of catastrophe models to make allowance for natural peril costs and any reinsurance costs, and finally allowing for consumer behaviour and market conditions.

14 Broadly, the objective is to set prices that accurately reflect the risk of each individual policy – a process known as *risk-based pricing*. Where this objective is not met, there are adverse consequences for insurers. Because of the competitive market for insurance, customers whose underlying risk is better than assumed for pricing will move to insurers who offer lower premiums, whereas customers whose underlying risk is worse than assumed for pricing will stay with their existing insurer. This means that an insurer that misprices will accumulate customers with higher risk than they price for, potentially leading to inadequate premiums and unsustainable financial losses. Competition should therefore drive insurers to ensure that they have accurately priced individual risks.

15 Over time, risk-based pricing can also have the positive effect of sending economic signals about risk and providing financial incentives for risk mitigation and adaptation, thus lowering aggregate costs for all Australians over time.

Actuaries consider the impact of climate change on costs of natural disasters

16 Scientific advice from the Intergovernmental Panel on Climate Change[1] alerts actuaries to the potential changes in frequency and severity of natural perils (excluding earthquake and tsunami) which will have implications for damage to property and financial consequences for insurers. As part of their roles, actuaries may:

- consider the allowance for climate change in models for natural disaster risk,
- adjust pricing for expected changes in natural disaster risk and any changes to reinsurance costs,
- perform stress testing and scenario analysis in order to assess an insurer's capital adequacy and reinsurance requirements, and
- consider the long-term impact of climate change and how insurers can develop strategy to manage these changes.

17 It is important to note that, in general, actuaries price insurance policies to reflect the risk which is expected to arise during the policy period. Most general insurance policies covering property risks have policy terms of one year. Climate change is expected to arise over decades, and this makes it difficult to assess the impact of climate change on policies of one-year duration given the inherent variability of losses from natural disasters from year to year.

Actuaries provide advice on investment strategy

18 In response to climate change, many global economies are undergoing a transition towards net zero emissions, such as the transition from fossil fuels to renewable energy sources, consistent with the objectives of international climate agreements and national government policies. This transition gives rise to risks and opportunities, especially for investors. Insurers have large investment portfolios that finance future claims payments and capital reserves, and actuaries may provide advice to insurers (and other companies) on the impact of climate change on investment risks and returns and the development of appropriate strategies to manage climate-related risks and opportunities.

Actuaries provide advice on disclosure of climate-related risks and opportunities

19 Actuaries may also advise insurers on climate-related disclosures, such as the implementation of the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) of the Financial Stability Board of the G20. This includes reporting to investors on the governance, risk

[1] IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Geneva: IPCC. Retrieved from https://www.ipcc.ch/report/ar5/syr/

management, strategy, scenario analysis, and metrics and targets deployed by insurers to manage climate-related risks and opportunities.

The Actuaries Institute undertakes research into Climate and Disaster Risk and participates in public discourse

20 Recognising the role actuaries perform, the Actuaries Institute has a policy on the Economic Implications of Climate Change. Under this policy it formed the Climate Change Working Group in 2016, which:

- seeks to educate the profession on Climate Change through research, speaking at conferences and publishing articles; and
- participate in public discourse on the economic implications of climate change, including in areas such as natural disaster resilience, and funding mechanisms for resilience.

Much of this work is summarised or referenced in the Actuaries Institute submission to this Royal Commission.

Q3 Explain the background to the Australian Actuaries Climate Index (AACI), including:

(a) the reason(s) for creating the AACI;

(b) the key data and information sources used to create and update the AACI;

(c) the key limitations of the AACI (if any);

(d) any comparative indices in other jurisdictions, including the North American Actuaries Climate Risk Index (ACRI), and how they differ (if at all);

(e) how indices such as the AACI and the ACRI are used.

3(a) The reason(s) for creating the AACI

21 The Australian Actuaries Climate Index (AACI) is designed to help inform actuaries, public policymakers, companies and the general public about climate trends in Australia. A key focus of actuarial work is understanding the "tail risk" of extreme events, such as those that were experienced in the recent bushfire season. The AACI focuses on trends in extreme values (such as the top 1% of observations), which are intended to add to our understanding of how weather and sea level related risks may be changing as a result of climate change. The index was launched by the Actuaries Institute in late 2018.

3(b) The key data and information sources used to create and update the AACI

22 The six components of the AACI are:

- Frequency of daily maximum and minimum temperatures above the 99th percentile ('High temperature').

- Frequency of daily maximum and minimum temperatures above the 1st percentile ('Low temperature').
- Frequency of rainfall over five consecutive days above the 99th percentile ('Precipitation').
- Seasonal maximum consecutive dry days ('Consecutive dry days').
- Frequency of daily wind speed above the 99th percentile ('Wind').
- Seasonal maximum sea level ('Sea level').

23 The AACI composite index reflects a simple average of the high temperature, rainfall and sea level component indices (that is, they are given equal weight in the AACI). It is intended to bring several of the metrics into a single headline measure. The wind data was excluded as data was not available back to 1981. The low temperature measure was excluded so that temperature was not overweighted in the composite index. The drought measure was excluded as it shows a strong inverse correlation with the rainfall measure - i.e. low rainfall is naturally associated with consecutive dry days.

24 For each component index the time series begins in 1981. The start dates for the wind indices are later, noting that the change in wind measurement devices (anemometers) contributed to a discontinuity in the data. The wind indices start from the date of installation of new anemometers.

25 The index is available nationally and for 12 regions of Australia. The regions are based on CSIRO's 15 sub-clusters used for its 'Climate Change in Australia' data. There are only 12 zones in the index as we grouped some clusters where there was insufficient data for them to be assessed in isolation. These zones are intended to be climatologically consistent regions of Australia.

26 Aggregation over a region, country or at the overall AACI level takes the average of all the relevant grids (or stations). Regions are divided along existing state and provincial borders and are of roughly similar size.

27 The indices are based on measurements taken by the Bureau of Meteorology (BoM) from its extensive network of meteorological and coastal tide stations. More specifically:

- The temperature measures are based on the 112 ACORN-SAT stations. This data has been homogenised by the BoM to ensure consistency over time.
- The rainfall data is based on all weather stations across Australia that collect rainfall data (around 2,000 stations).
- The wind data is based on 38 stations that are thought to provide the most reliable wind data, noting that wind measurement is inherently more uncertain.
- The sea level data is based on 16 tide gauges around the country and are taken from the BoM's Baseline Sea Level Monitoring Project.

- The data is summarised by meteorological season (three months ending February, May, August, and November), and a 5-year moving average was selected as the key metric.

3(c) The key limitations of the AACI (if any)

28 Currently the link between the AACI and the subcomponent indices to the financial and economic cost of natural disasters is implicit rather than explicit.

29 As discussed further in paragraphs 40 and 41, the link between extreme events and the financial and economic cost of natural disasters also depends on exposure (the number, value and type of property at a location) and vulnerability (how much damage is caused by the extreme event). The AACI currently does not incorporate exposure and vulnerability information.

30 Further research could be undertaken to develop additional indices measuring specific risk attributes by looking at the relationship between the data on extremes and historical insurance claims data, such as the risk of damage to property from a specific natural peril. This is an area of potential interest to the Actuaries Institute.

31 Another area of research is the potential impact of extreme events on human life and health. Up until now, the impact of climate change on human mortality and morbidity has not been explicitly identified. The bushfires of 2019/2020 have highlighted that climate change could cause extreme events that in turn impact air quality and therefore human mortality and morbidity. These are also areas of potential interest to the Actuaries Institute.

3(d) Any comparative indices in other jurisdictions, including the North American Actuaries Climate Risk Index (ACRI), and how they differ (if at all)

32 The Actuaries Climate Index (ACI) is a similar index available for North America, covering the USA and Canada, available as a composite index and by components. It is a joint endeavour by the American Academy of Actuaries, Canadian Institute of Actuaries, Casualty Actuarial Society and the Society of Actuaries. The ACI was launched in late 2016 and following a methodology review was relaunched in 2019. It is updated quarterly.

33 The key differences between the AACI and the ACI are:

- Reference period: The AACI uses 1981 to 2010, whereas the ACI uses 1961 to 1990. A more recent period means better quality data and a more contemporary view of changes in risk.
- Definition of exceedance threshold: The AACI focuses on the 99^{th} percentile whereas the ACI uses the 90^{th} percentile. It is a matter of judgement as to which provides the most useful measure, and this can also depend on data availability. In Australia, the Actuaries Institute decided that a more extreme threshold provides a better link to risk. Both the AACI and ACI show similar overall trends.
- Wind: The AACI is based on the maximum wind gust each day. The ACI uses the average wind speed over 24 hours.

- Sea level: The AACI is based on the maximum sea level for the month whereas the ACI uses the mean.
- Composite index: The AACI is based on only three component indices, whereas the ACI is based on all six.

34 The AACI and the ACI are therefore not directly comparable, though both seek to address the same questions.

35 The North American actuarial organisations have also been working on an Actuaries Climate Risk Index (ACRI) and one organisation, the American Academy of Actuaries, has released preliminary findings[2]. The ACRI is designed to "assist in answering the question: Are the extreme weather conditions that result from a changing climate producing increased property losses?". At a high level, the ACRI seeks to establish the relationship between the ACI composite index and insurance losses by region, which can be aggregated to national level.

36 Other global actuarial associations are considering similar climate indices, each tailored according to their own data availability.

3(e) How indices such as the AACI and the ACRI are used

37 As indicated on the websites for the AACI and ACI (which also includes the ACRI) the indices are designed to inform public discussion.

38 The AACI "is designed to provide an easy to interpret and valuable metric for actuaries, policy decision-makers and the general public to refer to when monitoring changes in climate". It is also noted that the Actuaries Institute "would not expect the indices to be used to directly price risk (such as setting insurance premiums) since they are not based on risk measures but are correlated to them".

Q4 Identify and describe any other recent research or initiatives with respect to climate, severe weather, natural peril and/or natural disaster risk in Australia to which the Actuaries Institute has contributed or is contributing, including:

(a) the Climate Measurement Standards Initiative (CMSI); and

(b) compliance with frameworks for entities to:

(i) assess, manage, and disclose climate-related risks,

(ii) undertake, or submit to, climate-related risk vulnerability assessment.

39 We first provide some context for our response to this question, which also anticipates some of our responses to question 5.

[2] https://www.actuary.org/sites/default/files/2020-01/ACRI.pdf

The financial cost of natural disasters

40 Disaster risk is a combination of three factors: exposure, hazard and vulnerability. These are key inputs into statistical models that simulate thousands of scenario outcomes to assess the financial implications.

- **Exposure** is the information about the properties in the portfolio – e.g. property location, property value, features of the building and location of the property.
- **Hazard** information is the behaviour of natural perils – e.g. type of hazard, locations impacted, frequency and severity.
- **Vulnerability** is the relationship between hazard and financial loss – e.g. the dollar amount of damage to a home, relative to the value of the home, given a hazard of a particular severity. Vulnerability is driven by the design and materials used, and any risk mitigation measures taken for the particular property.

41 Insurers estimate the cost of natural disasters to a particular property by assessing the frequency of hazards and their associated severity at the location of the property. This is combined with the vulnerability of the property to a hazard of that type, in order to estimate the cost of a hazard of that size on the property. By combining this across all possible types of hazard sizes and their frequency, insurers can estimate the expected cost of natural disasters to that property. By repeating this for all properties to which insurers have an exposure, insurers can estimate the total expected cost of natural disasters to their portfolio.

Technical challenges in performing climate-related physical risk scenario analysis

42 As noted in paragraph 19 above, investors and regulators are requesting disclosure by insurance companies (and others) on their climate-related risks and opportunities. The TCFD recommendations have been developed by investors and are strongly supported by insurance regulators globally. Significantly, this requires Insurers to perform scenario analyses – i.e. to consider what the financial impact would be if temperatures rise by, for example, less than 2°C or greater than 2°C by 2100.

43 This is a significant technical challenge for general insurers. Climate change is expected to have an impact on **hazards** – i.e. the frequency, severity and location of natural perils in Australia. However, significant further work is required to understand this fully. Research suggests that at an overall level climate change is expected to increase natural disaster risk, but at a local level some risks may increase, and others may decrease.

44 Further scientific research is needed to enable the outputs of climate models to be used in modelling the behaviour of extreme events at a local level. Historical scientific research into climate change has focused on *weather variables*, such as temperature and rainfall, but natural disaster risk is driven by *extreme events* at a local level like tropical cyclones, floods and bushfires. The relationship between these climate variables and extreme events is not straightforward.

45 The models used by insurers are generally *statistical models* based on historical events – i.e. they are based on re-simulations of the past. In contrast, climate models are *physical models* – i.e. they use the laws of physics to model climate behaviour. There is no straightforward way to link these types of models, and substantial research is required to bring these disciplines together into an integrated framework that allows insurers to convert climate scenarios into financial impact.

46 Insurers are concerned with very local risks. As discussed in paragraph 13 above, actuaries price insurance for *individual properties* in order to ensure premiums match the risk. For example, the risk of flooding for a house at the bottom of the hill next to a river is very different to risk for a house on the same street but at the top of the hill. This requires data at a very high level of resolution (typically <10m). Global Climate Models, such as those examined by the IPCC, generally have very low resolution (typically 100 km). Various methods are available to perform downscaling of global climate models to regional levels with higher resolution. However, in Australia this downscaling is being done at the state level, rather than for the country as a whole, leading to inconsistent approaches, gaps in coverage, and difficulties for users such as insurers attempting to develop a consistent approach across the country.

47 The above issues are further complicated by the fact that extreme weather events are, by their nature, rare. For example, while Australia may experience three or four tropical cyclones each year, the frequency of such events at an individual city level is substantially lower. Because Australia's population is concentrated in the capital cities, the data for events that have an impact on our population and insurance are even more sparse. This lack of data contributes to uncertainty in our estimates of premiums.

48 In order to manage climate and disaster risk, we need to better understand **vulnerability**. This is primarily driven by **building standards**. The Actuaries Institute has made important recommendations in this area in its submission to the Commission. Further research is required to understand the cost-effective measures that can be taken to reduce vulnerability and financial loss as climate change increases the frequency and severity of extreme events and tests the resilience of homes and businesses.

49 **Improved land use and planning** will assist in reducing **exposure** to properties that face worsening hazards and have high vulnerability. For example, this means understanding how flood zones may change over time because of climate change and ensuring that we plan to avoid development in existing and future flood zones. Similar considerations apply to tropical cyclones and bushfires, as well as coastal inundation for coastal properties.

4(a)(i) CMSI

50 The CMSI is an industry-led collaboration between Australian banks, general insurers and asset owners to develop guidance on scenario analysis for TCFD reporting on the impact of climate on natural disasters (climate-related physical risk).

51 Funding members of the CMSI include QBE, Suncorp, IAG, Munich Re, Swiss Re, CBA, NAB, Westpac, RACQ, HSBC Australia and Leadenhall Capital Partners. The Steering Group also includes Climate-KIC Australia and Investor Group on Climate Change. There are several actuaries involved in the working committees and steering group of the CMSI.

52 The project has two main goals:

- To provide guidance on interpretation of the TCFD in the context of the banking, general insurance and asset owner sectors in Australia
- To obtain scientific advice in addressing the challenges discussed in paragraphs 42 to 47 above on assessing changes in hazards due to climate change, including the development of scenarios to be used in TCFD scenario analyses.

53 The CMSI is working with the Earth Systems and Climate Change (ESCC) Hub, which is a partnership between CSIRO, the Bureau of Meteorology (BoM) and five Australian universities. The ESCC Hub's climate change experts are providing the CMSI with robust scientific advice on how climate change is expected to affect hazards.

54 The CMSI is aiming to produce a draft report for consultation in June 2020.

55 The CMSI does not expect to resolve all issues in relation to climate and disaster risk. The report will also include a roadmap for further research required to improve the data and assumptions used by the financial sector in performing TCFD scenario analysis for climate and disaster risk.

4(a)(ii) ASFI

56 The Australian Sustainable Finance Initiative (ASFI)[3] is a collaboration of industry participants working towards a roadmap for sustainable finance in Australia. The roadmap, to be launched in 2020, will recommend pathways, policies and frameworks to enable the financial services sector to contribute more systematically to the transition to a more resilient and sustainable economy, consistent with global goals such as the UN Sustainable Development Goals and the Paris Agreement on climate change and the Sendai Framework.

57 ASFI has a technical working group (TWG3) on Making Better Informed Decisions, which I co-chair, that is also looking at data challenges. It expects to release several recommendations for improving resilience to natural disasters.

58 A progress report[4] and a summary[5] were issued in December 2019, where access to tools, standards and data were recognised as one of the challenge to be addressed by the

[3] https://www.sustainablefinance.org.au/

[4] https://www.sustainablefinance.org.au/s/ASFI-Progress-Report-Final.pdf

[5] https://www.sustainablefinance.org.au/s/Summary-Final.pdf

recommendations. ASFI is also considering how the private sector can mobilise capital to invest in resilience measures.

4(a)(iii) Federal Government and CSIRO

59 The general insurance industry also consulted with the National Resilience Taskforce (NRTF) which did some excellent work on climate and disaster risk, including its report[6] on Australia's National Vulnerability and a strategic approach to managing vulnerability[7].

60 The NRTF framework and guidance on strategic decision making is also very helpful at explaining the systemic challenges in addressing climate and disaster risk[8].

61 Through our consultations with CSIRO, we understand it is about to launch a Navigating Climate Change (NCC) mission to catalyse a national response to climate risk. NCC intends to build a national climate risk capability by 2025 to address the risk to Australia's economy posed by a changing climate, and the current limitations on understanding, disclosing and responding to climate risk. It will include a comprehensive platform including data, projections, hazards, impacts, adaptation and transition. The CMSI is seeking to work closely with the NCC in order to provide industry engagement.

62 More broadly, we understand through our consultations that the ESCC Hub is developing a strategy for a National Climate Services Capability, which seeks to develop climate services capability delivering both standardised, quality-assured, easily accessible and relevant data, together with public-private partnerships to deliver tailored climate services to multiple end users.

4(a)(iv) Insurance Council of Australia's Climate Change Action Committee (CCAC)

63 Actuaries are members of the ICA's CCAC[9]. The CCAC is a multidisciplinary collaboration of insurance experts with a mandate to:

- Support the insurance industry to embed climate change issues and insights into decision making;
- Work with stakeholders to raise awareness of climate change and the impacts of climate change, manage risk and develop solutions including awareness of disaster preparedness in communities, and improve disaster response and recovery;

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[6] https://www.aidr.org.au/media/6682/national-resilience-taskforce-profiling-australias-vulnerability.pdf

[7] https://knowledge.aidr.org.au/media/7710/03-vulnerability-guidance-strategic-decisions-climate-disaster-risk-2020.pdf

[8] https://knowledge.aidr.org.au/resources/strategic-disaster-risk-assessment-guidance/

[9] https://climaterisk.insure/

- Work with governments, regulators and other key stakeholders to promote action on climate change and other environmental issues; and
- Support industry disclosure of climate risks and opportunities.

64 Several ICA members are also contributing funding and data on a project to assess the vulnerability of modern homes to tropical cyclones and flood and the suitability of current building codes in Australia. This project is being run by Risk Frontiers and the James Cook University Cyclone Testing Station. The outcomes will be open source wind vulnerability curves for use in catastrophe modelling assessment, produced from a systematic analysis of whole-of-industry claims and policy data. The study is intended to provide an understanding of the drivers of losses between different building archetypes and ancillary structures. The resultant expert peer-reviewed technical report will be available to inform decision-makers on building standards and codes.

65 Further vulnerability projects on other hazards are also anticipated by the CCAC, subject to the availability of funding and data.

4(b) Frameworks

66 As noted in paragraph 19 above, the TCFD recommendations provide a framework for the disclosure of climate-related risks. As part of implementing that framework, insurers need to develop capabilities to assess and manage climate-related risks.

67 In February 2020, the Australian Prudential Regulation Authority (APRA) set out a plan[10] to develop a prudential practice guide focused on climate-related financial risks, and to perform a climate risk vulnerability assessment, beginning with Australia's largest banks, but expected to extend to the remainder of APRA-regulated financial institutions. While the timetable for these actions have been delayed because of the impact of COVID-19, APRA is expected to continue with these activities once the impacts of COVID-19 have abated.

68 The Actuaries Institute's Climate Change Working Group is developing an Information Note to assist Appointed Actuaries in general insurance, life insurance and health insurance in providing advice to the Boards of insurers on the financial impact of climate change. This Information Note is intended to complement APRA's prudential practice guide on climate-related financial risk.

69 The CMSI is also consulting with APRA, Industry and CSIRO on approaches to support the financial services industry in performing the APRA vulnerability assessment. APRA has indicated that it will consider similar international activities by peer regulators. The leading practice in this area is from the Bank of England, which has set out a consultation paper on its 2021 Biennial Exploratory Scenario that will include climate risk.

[10] https://www.apra.gov.au/understanding-and-managing-financial-risks-of-climate-change

70 APRA's vulnerability assessment will include climate-related physical risks, as well as an assessment of the risks and opportunities arising from the transition to a zero-carbon economy, and the macro-economic impacts of climate change. APRA has recognised the challenges in performing this assessment and had indicated it is working with CSIRO.

Q5 What steps could be taken to improve the actuarial assessment of natural disaster risk in Australia. In answering this question, identify any gaps or limitations in access to, and availability of, data and information used in actuarial assessment of natural disaster risk in Australia.

71 Paragraphs 42 to 49 above outline some of the challenges facing actuaries in the assessment of natural disaster risk in Australia.

72 As noted above, the CMSI is seeking to develop a roadmap for further research needed in assessing the impact of climate change on natural disaster hazards.

73 As well as the existing initiatives described above, the following steps could substantially improve the assessment of climate and natural disaster risk in Australia. This initial list would require further refinement and consultation across a range of stakeholders, feasibility testing, cost/benefit assessment, and prioritisation before implementation.

(a) A coordinating national body or approach to drive the production of downscaled high-resolution climate data across all parts of Australia (for reasons outlined in paragraph 46), including assessment of extreme events such as cyclones, floods, bushfires, storms and hail, coastal inundation and clay soil contraction.

(b) Improved meteorological and other data capture, including a program of investment in improved weather stations across Australia, to provide complete, up-to-date, reliable data of enough resolution to improve climate and disaster risk modelling.

(c) More refined projected forest fire danger index scores for future climate conditions. While historical information is available at 5km grids, projections are only available for 40 weather station sites across Australia. Increasing the number of locations for which projections are provided may enable improved actuarial assessment as well as improved climate and disaster resilience.

(d) Public availability of flood hazard maps across Australia (currently these are driven by individual councils), including a consistent specification for such studies (currently different councils use different definitions). This would improve consumer awareness.

(e) Collation across Australia of the impacts of sea level rise and coastal inundation risk information. Much of this work is again undertaken at a local council level and with inconsistent approaches. This should also be publicly available to improve consumer awareness.

(f) Improved open source modelling of natural disaster risks incorporating climate change impacts that is consistent and complete across Australia. This modelling could be used

to inform a wide range of stakeholders, including all levels of government, emergency management, and the financial services industry including insurers. Over time, such modelling should cover severe convective storms and hail, flood, tropical cyclone and bushfire hazards.

In recent years insurers have observed increasing frequency of severe convective storms and hail events and resulting losses. While there are existing flood, tropical cyclone and bushfire models, these can benefit from further research on the impact of climate change, and wider availability to stakeholders would enable better decision making and climate and disaster risk reduction.

(g) Research into the interaction between climate change on the El Niño-Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD) and the Southern Annual Mode (SAM) with reference to weather related events and subsequent losses. These phenomena can have a significant impact on natural disasters, and any structural change due to climate change will have important policy implications.

(h) Publicly available high-quality up-to-date exposure and vulnerability data across Australia for all buildings and infrastructure. This would include critical data on property location, value, construction type, roof type, year of build, compliance with code and other vulnerability information. This would enable much better assessment of climate and disaster risk across Australia and the targeting of resilience and mitigation activity.

(i) A national centre of excellence to research resilient building design and materials for new and retrofitted residential and commercial buildings. This centre would provide data and advice to COAG's Australian Building Codes Board on the incorporation of cost-effective resilience measures within building codes. Such a centre of excellence would include advanced testing facilities to develop scientific evidence to support such changes. The insurance industry can then work with this centre to complete vulnerability assessments across all perils.

(j) Development of a national strategy to address resilience in existing buildings and infrastructure (such as urban drainage systems, levies and dams) and, in conjunction with the insurance industry and other stakeholders, development of a prioritised list of resilience building projects. This would include implications for building codes required in regions where the vulnerability of buildings to hazard is changing, e.g. changes in flood or cyclone zones may require changes to building codes appropriate for a location. Such information would allow actuarial assessment to include future changes in vulnerability, and to assess the costs and benefits of each project.

(k) Development of a national strategy to embed climate and disaster risk considerations into land use and planning, including close consultation with insurers. This would be followed by projections of future property development in line with that strategy in order to allow the industry to understand future exposure growth and its impact on climate and disaster risk, which can then be incorporated into actuarial assessments.

Signed by Sharanjit Paddam)

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on 21 May 2020)

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.....Kristie Mammen.....

Signature of witness